Technical and Environmental Evaluation of Geothermal-Driven Hydrogen Production in Mexico

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ABSTRACT

Mexico has the potential to develop 9,686 MW of geothermal energy (GTE). As a renewable source, GTE could not only generate electricity but also heat and power for hydrogen electrolysis. Derisking GTE is a critical step for developing these energy systems. This study aims to model a GTE and hydrogen production (GTE+H2) operation in the geothermal greenfield of Santiago Papasquiaro, Durango, Mexico. Technical, economic, and environmental parameters are assessed by coupling a series of computational models. The geological uncertainty of the greenfield is evaluated with Monte Carlo simulation and statistical distributions. The field yields a theoretical expected value of 27 MW. Techno-economical modeling of a geothermal binary power plant reveals a 10.35 MW electricity capacity with two production and two injection wells for 30 years with a project net present value of $29.11 M and an internal rate of return of 10.28%. The modeled power plant leads to 480 tCO2 avoided. Four main parameters are identified for a competitive levelized cost of hydrogen (1.5–2$/kgH2) through a sensitivity analysis of the technology progress model of GTE+H2, which are (1) GTE CAPEX, (2) electrolyzer CAPEX, (3) electrolyzer efficiency, and (4) electrolyzer OPEX. Beyond assessing the cost competitiveness, the community benefits of GTE+H2 deployment could avoid up to 206 deaths caused by PM2.5 emissions. The results presented suggest that the deployment of GTE+H2 in the selected site in Mexico is techno-economically feasible and can strengthen the energy and fuel diversity of the country while improving air quality conditions for neighboring communities.

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